Remarks

The above Amendments and these Remarks are in reply to the Office Action mailed December 3, 2001. Claims 1-10, 12-20 are presented herewith for consideration.

Rejection of Claims 1-20 Under 35 U.S.C. §112

It is respectfully submitted that Claims 1-10, and 12-20 as amended particularly point out and distinctly claim the subject matter which applicant regards as the invention, and hence are in compliance with 35 U.S.C. §112, second paragraph.

The Examiner's comments on the issues with the claims are appreciated. Reconsideration of the claims in light of the amendments included herewith is respectfully requested.

Rejection of Claims 1-20 Under 35 U.S.C. §102(e) and 35 U.S.C. §103

The Claimed Invention is not Anticipated by *Clark et al.*

It is respectfully submitted that the invention defined in Claims 1 – 10 and 12 – 20 is not anticipated by nor obvious in view of U.S. Patent No. 6,230,563 to Clark et al. ("*Clark et al.*").

In particular, "[a] rejection for anticipation under section 102 requires that each and every limitation of the claimed invention be disclosed in a single prior art reference." In re Paulsen, 30 F.3d 1475, 31 USPQ2d 1671 (Fed. Cir. 1994).

It is respectfully submitted that, with respect to claim 1, *Clark et al.* fails to disclose:

> a second finger set ..., wherein said at least one second finger is substantially closer to one of the two first fingers between which said at least one

> second finger terminates; ... (EMPHASIS SUPPLIED).

While *Clark et al.* discloses "fingers", it does not disclose "...at least one second finger ... substantially closer to one of the first two fingers...".

Hence it is respectfully submitted that claim 1, and claims 2 – 3 are not anticipated by *Clark et al.*

Claim 4 provides similar features in limitations calling for:

> ... at least one second ... closer to one of the two first fingers between which said at least one second finger terminates, thereby forming a capacitor; ... (EMPHASIS SUPPLIED)

Hence it is respectfully submitted that claim 4, and claims 5 –10, 11 – 12 are not anticipated by *Clark et al.*

Claim 13 includes limitations similar to the forgoing limitations in claims 1 and 4, and includes additional features not shown in *Clark et al.*:

> said at least one second finger extending substantially parallel to said first displacement axis ... *closer to one of the two first fingers between which said at least one second finger terminates*, thereby forming a first capacitor;
>
> ...
>
> a fourth finger set comprising at least one fourth finger, ...said at least one fourth finger is closer to one of the two third fingers between which said at least one fourth finger terminates, thereby forming a second capacitor; ... (EMPHASIS SUPPLIED)

Clark et al. does not disclose either the "second finger" nor the "fourth finger" meeting the structural limitations set forth above. Nor does it disclose the "electrical circuit" as defined in claim 13.

Hence it is respectfully submitted that claim 13, and claims 14 – 19 dependent from claim 13, are not anticipated by *Clark et al.*

Finally, claim 20 includes limitations similar to those set forth above and additional limitations calling for features not disclosed in *Clark et al.*:

> ... at least one second finger ... substantially closer to one of the two first fingers between which said at least one second finger terminates, thereby forming a capacitor; (EMPHASIS SUPPLIED)

Hence it is respectfully submitted that claim 20 is not anticipated by *Clark et al.*

Reconsideration of claims 1-10 and 12-20, each having limitations to features not disclosed in *Clark et al.*, and hence not being anticipated by *Clark et al.*, is respectfully requested.

<u>The Claimed Invention is not Obvious in View of *Clark et al.*</u>

As noted above, the invention as defined in the pending claims includes features not present in *Clark et al.*

One such feature is the positioning limitations set forth in each independent claim (and by their dependency, each dependent claim) calling for:

> ... at least one second finger ... substantially closer to one of the two first fingers between which said at least one second finger terminates, thereby forming a capacitor;

As noted in the specification, this structure provides "a non-zero force for quadrature-error cancellation" (p.15 lines 1-4: "To obtain a nonzero force for quadrature-error cancellation, the gaps separating comb finger sets must not equal the gap between comb-fingers within a single set, i.e. Y_1, the distance to the next set, should not equal Y_2.").

These features provide the attendant advantages of the invention, as explained in the specification at page 17, lines 2 - 14:

> When Y_1 is not equal to Y_2, F_y is a function of relative X-axis displacement, and correspondingly appears as an off diagonal element when represented in spring matrix form. ... An important advantage of the present invention may now be

> noted. *When the comb-finger capacitors comprise a conductive material, and the voltage across the comb-finger capacitor is provided by a low-impedance voltage source, ... there is essentially zero phase error between proof-mass position along the drive-axis and the force F_y.* An in-phase relationship between these two quantities enables effective cancellation of off-diagonal terms in the spring-matrix, thereby providing improved oscillation. *(EMPHASIS SUPPLIED)*

In addition, only one reduced complexity is provided since convective voltage need only be applied to the fingers, as stated at page 25, line 20 to p. 26, line 24:

> Some prior-art active quadrature-error correction techniques require multiple electrical nodes closely-spaced adjacent to each other, resulting in increased parasitic capacitance, increased wiring complexity, and increased size. Depending on the technology in which the gyroscope and quadrature-nulling structures are formed, the present invention may be highly advantageous because ***only two electrical nodes are required for each independent quadrature-nulling structure, only one node being anchored to the substrate. Thus, interconnection between like comb-fingers of a quadrature-nulling structure is greatly simplified – especially when fingers are formed in a single-crystal-silicon fabrication technology such as described in*** (Clark, et al., US Patent Application 09/322,381 filed 5/28/99; Clark, et al., US Provisional Patent Application 60/127,973 filed 4/6/99; Brosnihan, et al., US Patent Application 08/874,568 filed 6/13/97; Diem, et al., US Patent 5,495,761 issued 3/5/96; Offenberg, et al., US Patent 5,627,317 issued 5/6/97; Shaw, et al., US Patent 5,719,073 issued 2/17/98). ***Simple interconnection may translate to significantly reduced pitch between adjacent quadrature-nulling finger-pairs thereby reducing sensor area. Furthermore, parasitic capacitance between adjacent sets of comb fingers may be reduced, as compared to prior-art quadrature-error cancellation structures*** (see for example Clark, et al., US Patent 5,992,233 issued 11/30/99; **Clark, et al., US Patent Application 09/321,972 files 5/28/99**) leading to improved electrical characteristics when the quadrature-error cancellation structures are included in a feedback loop that measures the quadratur

> error and adjusts bias voltages accordingly. Furthermore, parasitic capacitance can slow settling and stability of voltages applied across quadrature-cancellation structures, thereby introducing a phase error between proof-mass position along the drive-axis and the force F_y.

(It should be noted that the distinction between the present invention and *Clark et al.* was noted in the text of the application.) Hence, in the present invention, the structure allows use of a novel and non-obvious mechanism of correction of quadrature error through use of a "single voltage force proportional to displacement."

Clark et al. teaches a "balanced quadrature-nulling structure" (col 8, line 58 – 59), which uses adjustment of the "common mode or differential bias voltages" to vary the sign of the quadrature nulling force. Such biases may be open loop or adjusted using feedback of measured quadrature error.

There is no teaching or disclosure of the above claimed structural features, nor error correction mechanism, in *Clark et al.*

Moreover, *Clark et al.*, while discussing the problems to be solved as similar, does not suggest the claimed features as a solution to those problems. In particular, *Clark et al.* discloses equally spaced comb fingers and there is no teaching or suggestion of varying the y-axis distance of the central finger relative to the surrounding fingers (See Figures 13 and 14). Moreover, there is no suggestion that varying the physical position of the y-axis displacement of the comb finger would lead to an alternative solution for applying a voltage in the advantageous manner noted in the present application.

Hence one of average skill in the art would be required to devise a significant, separate and distinct feature not shown or suggested in the prior art in ord r to make and use th invention as defined in the present claims.

It is respectfully submitted that one of averag skill in the art would thus not find the invention as defined herein obvious in view of the teachings of *Clark et al.*

Based on the above amendments and these remarks, reconsideration of Claims 1 – 10 and 12 - 20 is respectfully requested.

The Examiner's prompt attention to this matter is greatly appreciated. Should further questions remain, the Examiner is invited to contact the undersigned attorney by telephone.

Enclosed is a PETITION FOR EXTENSION OF TIME UNDER 37 C.F.R. § 1.136 for extending the time to respond up to and including today, May 3, 2002.

The Commissioner is authorized to charge any underpayment or credit any overpayment to Deposit Account No. 501826 for any matter in connection with this response, including any fee for extension of time, which may be required.

Respectfully submitted,

Date: May 3, 2002

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APPENDIX

Below are a copy of claims 1, 4, 5, 7-10, 12, 13 and 16-20 showing the amendments.

1. A movable microstructure comprising:

a first finger set comprising two or more first fingers extending substantially parallel to a first displacement axis;

a second finger set comprising at least one second finger, said at least one second finger extending substantially parallel to said first displacement axis, terminating between said two first fingers, wherein [each] said at least one second finger is substantially closer to one of the two first fingers between which [it] said at least one second finger terminates; and

an electrical circuit providing a position-dependent force having a magnitude varying in proportion to displacement along said first displacement axis.

4. A movable microstructure comprising:

a substrate;

a proof-mass disposed above said substrate;

a first finger set comprising two or more first fingers extending substantially parallel to a first displacement axis from said proof-mass;

a second finger set comprising at least one second finger, [each member of the] said at least one second finger [set] is affixed to said substrate and extending substantially parallel to said first displacement axis towards said proof-mass, terminating between said two first fingers, wherein [each] said at least one second finger is closer to one of the two first fingers between which [it] said at least one second finger terminates, thereby forming a capacitor; and

an electrical circuit providing a voltage across said capacitor to provide a position-dependent force on said proof-mass, said position-dependent force having a component along an axis substantially orthogonal to said first displacement axis, the magnitude of said position-dependent force varying in proportion to displacement along said first displacem nt axis.

5. The movable microstructure of claim [3] <u>4</u> further including an oscillation-sustaining feedback loop having an output representative of proof-mass displacement along said first displacement axis, said oscillation-sustaining feedback loop using electrostatic forces to sustain oscillatory motion.

7. The movable microstructure of claim 5 wherein the voltage applied to said first capacitor is substantially constant and chosen to cause said [vibrating] <u>proof</u> mass, absent a Coriolis force, to vibrate more precisely along said first axis.

8. The movable microstructure of claim 6 further including:

a quadrature detection circuit having an output, said quadrature detection circuit synchronized with the output of said oscillation-sustaining feedback loop; and

a feedback connection from the output of said quadrature detection circuit to said first capacitor, said feedback connection providing a voltage across said first capacitor;

wherein said voltage <u>provided by said feedback connection</u> causes the average output of said quadrature detection circuitry to converge towards a constant value, thereby causing said mass to vibrate, absent a Coriolis force, more precisely along said first axis.

9. The movable microstructure of claim [4] <u>5</u> further including:

a third finger set comprising two or more third fingers affixed to said substrate and extending substantially parallel to [a] <u>said</u> first displacement axis towards said proof-mass; and

a fourth finger set comprising at least one fourth finger, [each member of the] <u>said at least one</u> fourth finger [set] extending substantially parallel to said first displacement axis from said proof-mass along a direction opposite the direction of extension of said second fingers, terminating between <u>said</u> two third fingers, wherein [each] <u>said at least one</u> fourth finger is closer to one of the two third fingers between which [it] <u>said at least one fourth finger</u> terminates, thereby forming a second capacitor.

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10. The moveable microstructure of claim 9 wherein said electrical circuit provides a <u>second</u> voltage across said second capacitor to provide a position-dependent force on said proof-mass, said position-dependent force having a component along an axis substantially orthogonal to said first displacement axis, the magnitude of said position-dependent force varying in proportion to displacement along said first displacement axis.

11. Please Cancel Claim 11

12. The movable microstructure of claim 9 further including:

a capacitive bridge responsive to displacements of said proof-mass along a sense axis orthogonal to said first displacement axis;

a position sense interface connected to said capacitive bridge, said position sense interface having an electrical output varying in response to changes in said capacitive bridge;

a quadrature detection circuit having an output, said quadrature detection circuit synchronized with the output of said oscillation-sustaining feedback loop;

a feedback connection from the output of said quadrature detection circuit to said first and second capacitors, said feedback connection providing a defined voltage across each of said first and second capacitors, said voltage causing the average output of said quadrature detection circuit[ry] to converge towards a constant value, thereby causing said mass to vibrate, absent a Coriolis force, more precisely along said first axis; and

a Coriolis detection circuit having an output, said Coriolis detection circuit synchronized with the output of said oscillation-sustaining feedback loop;

wherein the Coriolis detection circuit output provides an electrical signal representative of rotational motion about an axis largely orthogonal to both [said] <u>a</u> sense axis and said first displacement axis.

13. A movable microstructure comprising:

a substrate;

a first proof-mass disposed above said substrate;

a second proof-mass disposed above said substrate;

a first finger set comprising two or more first fingers affixed to said substrate and extending substantially parallel to a first displacement axis towards said first proof-mass;

a second finger set comprising at least one second finger, [each member of the] said at least one second finger [set] extending substantially parallel to said first displacement axis from said first proof-mass, terminating between said two first fingers, wherein [each] said at least one second finger is closer to one of the two first fingers between which [it] said at least one second finger terminates, thereby forming a first capacitor;

a third finger set comprising two or more third fingers affixed to said substrate and extending in a direction opposite said first finger set and substantially parallel to said first displacement axis towards said second proof-mass;

a fourth finger set comprising at least one fourth finger, [each member of the] said at least one fourth finger [set] extending substantially parallel to said first displacement axis from said second proof-mass, along a direction opposite said second fingers, terminating between said two third fingers, wherein [each] said at least one fourth finger is closer to one of the two third fingers between which [it] said at least one fourth finger terminates, thereby forming a second capacitor; and

an electrical circuit providing a first voltage across said first capacitor, and a second voltage across said second capacitor to provide position-dependent forces on said first proof-mass and on said second proof-mass, said position-dependent forces having a component along an axis substantially orthogonal to said first displacement axis, the magnitude of said position-dependent force varying in proportion to proof-mass displacement along said first displacement axis.

16. The movable microstructure of claim 14 wherein said first voltage and said second voltage ar distinct, are substantially constant, and are chosen to

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cause said [vibrating] each said proof mass, absent a Coriolis force, to vibrate more precisely along said first axis.

17. The movable microstructure of claim 15 further including:

a quadrature detection circuit having an output, said quadrature detection circuit synchronized with the output of said oscillation-sustaining feedback loop; and

a feedback connection from the output of said quadrature detection circuit to said first capacitor and said second capacitor, said feedback connection providing said first voltage and said second voltage;

wherein said first voltage and said second voltage cause the average output of said quadrature detection circuit[ry] to converge towards a constant value, thereby causing each said proof mass to vibrate, absent a Coriolis force, more precisely along said first axis.

18. The movable microstructure of claim 14 further including:

a fifth finger set comprising two or more fifth fingers affixed to said substrate and extending substantially parallel to a first displacement axis towards said first proof-mass in the direction of said first fingers;

a sixth finger set comprising at least one sixth finger, [each member of the] said at least one sixth finger [set] extending substantially parallel to said first displacement axis from said first proof-mass along the direction of extension of said second fingers, terminating between said two fifth fingers, wherein [each] said at least one sixth finger is substantially closer to the fifth finger opposite in direction of said first smaller gap in relation to said at least one second finger, thereby forming a third capacitor;

a seventh finger set comprising two or more seventh fingers affixed to said substrate and extending substantially parallel to a first displacement axis and towards said second proof-mass;

an eighth finger set comprising at least one eighth finger, [each member of the] said at least one eighth finger [set] extending substantially parallel to said first displacement axis from said second proof-mass opposite the direction of the second fingers, terminating between said two seventh fingers, wher in [each] said at least one eighth finger is

substantially closer to the seventh finger opposite in direction of said second smaller gap in relation to said at least one fourth finger, thereby forming a fourth capacitor; and

an electrical circuit providing a third voltage across said third capacitor, and a fourth voltage across said fourth capacitor to provide position-dependent forces on said first proof-mass and on said second proof-mass, said position-dependent forces having a component along an axis substantially orthogonal to said first displacement axis, the magnitude of said position-dependent force varying in proportion to proof-mass displacement along said first displacement axis.

19. The movable microstructure of claim 18 further including:

a capacitive bridge responsive to the relative displacement between said first proof-mass and said second proof-mass along an axis orthogonal to said first displacement axis;

a position sense interface connected to said capacitive bridge, said position sense interface having an electrical output varying in response to changes in said capacitive bridge;

a quadrature detection circuit having an output, said quadrature detection circuit synchronized with the output of said oscillation-sustaining feedback loop;

a feedback connection from the output of said quadrature detection circuit to said first capacitor, said second capacitor, said third capacitor and said fourth capacitor, said feedback connection providing said first voltage, said second voltage, said third voltage and said fourth voltage; and

a Coriolis detection circuit having an electrical signal output representative of rotational motion about an axis largely orthogonal to both [said] a sense axis and said first displacement axis, said Coriolis detection circuit synchronized with the output of said oscillation-sustaining feedback loop[;].

20. A micromachined vibratory rate gyroscope comprising:

a substrate;

a proof-mass disposed abov said substrate;

a first finger set comprising two or more first fingers affixed to said substrate and extending substantially parallel to a first displacement axis towards said proof-mass;

a second finger set comprising at least one second finger, [each member of the] <u>said at least one</u> second finger [set] extending substantially parallel to said first displacement axis from said proof-mass, terminating between <u>said</u> two first fingers, wherein each second finger is substantially closer to one of the two first fingers between which [it] <u>said at least one second finger</u> terminates, thereby forming a capacitor;

an oscillation-sustaining feedback loop having an output representative of proof-mass displacement along said first displacement axis;

a capacitive bridge responsive to displacements of said proof-mass along an axis orthogonal to said first displacement axis;

a position sense interface connected to said capacitive bridge, said position sense interface having an electrical output varying in response to changes in said capacitive bridge;

a quadrature detection circuit having an output, said quadrature detection circuit synchronized with the output of said oscillation-sustaining feedback loop; and

a feedback connection from the output of said quadrature detection circuit to said capacitor, said feedback connection providing a voltage across said first capacitor;

wherein the voltage applied to said capacitor drives the output of said quadrature detection circuit[ry] towards a constant value, thereby causing said mass to vibrate absent a Coriolis force, more precisely along said first axis.